order, a most interesting historical notice of the first attempts to accurately estimate the visual power, the invention of the ophthalmoscope and the apparatus required for testing vision opens the volume. This is followed by a comprehensive description of presbyopia, myopia and hypermetropia.

Astigmatism in its various forms is taken up next, under which heading an extended account of ophthalmometry to its minutest detail is given. Asthenopia, particularly that which is found in association with binocular vision, is described in a graphic manner, while a number of useful general remarks as to lenses, spectacles and eye-glasses finish the volume.

A careful perusal of the contents of the work is recommended to any one who may be interested in the subject.

C. A. O.

BOOKS RECEIVED.

German Higher Schools; The History, Organization and Methods of Secondary Education in Germany. JAMES E. RUSSELL. New York, London and Bombay, Longmans, Green & Co. 1899. Pp. xii + 455.

Year-book of the United States Department of Agriculture, 1899. Washington, Government Printing Office. 1899. Pp. 768.

Imperial Democracy. DAVID STARR JORDAN. New York, D. Appleton & Co. 1899. Pp. viii + 293. $1.50.

Eighteenth Annual Report of the United States Geological Survey, 1896-97. CHARLES D. WALCOTT, Director. Part II., Papers Chiefly of a Theoretical Nature. Part IV., Hydrography. Washington, Government Printing Office. 1899.

SOCIETIES AND ACADEMIES.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

THE 306th regular meeting was held April 8th. The first paper entitled 'The Ferns of Hemlock Bluff' by Mr. Wm. Palmer included a preliminary sketch of the geology of Hemlock Bluff, a point on the Virginia shore of the Potomac between Georgetown and Great Falls. The locality is particularly rich in cryptogamic plants, over twenty species of ferns being enumerated.

A recent noteworthy addition to this list is that of *Asplenium pinnatifidum* hitherto unknown from the District of Columbia or the adjacent parts, and supposed to be confined to limestone rocks in mountain regions. The rocks at Hemlock Bluff are, however, gneissic. Mr. Palmer stated that this interesting and beautiful station is threatened with destruction, and expressed the hope that Congressional action would be taken in time to protect the banks of the Potomac from further devastation.

'Notes on the Habits of African Termites' was the subject of the second paper, read by O. F. Cook. On the basis of observations made in Liberia several points in the domestic economy of termites have been established. Among these may be mentioned the fact that some termites regularly collect rotting wood, which they put through a process of curing and then comminute into the pulp used in building the irregularly honeycombed fungus gardens which produce the food of at least the young animals of the colony. The soldiers of these species (*Termes bellicosus* and allies), which sally out from the nest in response to attacks by men or animals, do not return to the nest, but wander about and soon perish from exposure to the outside air. Other soldiers, the so-called *nasuti*, of which the head is produced above into a long beak, eject from this process, which is hollow, a transparent, acrid, malodorous and corrosive fluid, which forms a most effective means of defence against ants and other insect enemies, and renders them distasteful to birds. A third type of soldier can neither shoot nor bite, but the large, unequal mandibles are especially adapted to produce a loud clicking sound which furnishes protection at least against other species of termites. It was also found that the perfect insects associate in pairs when flying over water and that, after dropping their wings, such pairs are able to burrow into the ground, thus suggesting the possible origin of termite communities.

Under the head of 'Biological Characteristics as a means of Species Differentiation' Dr. Erwin F. Smith described in detail the very numerous culture-methods, reactions and other tests now in use in bacteriology. To accomplish all these investigations a species is sometimes carried in the laboratory for two years or longer. The insufficiency of the older and, indeed, of many of the more recent descriptions

was noted. The descriptive methods applicable to larger organisms here fail almost completely, necessitating that diagnoses depend upon physiological facts which receive little attention in the descriptions of species belonging to groups of greater structural complexity.

At the 307th meeting, April 22d, Dr. S. D. Judd gave an account of a recent observation on chimney-swifts. A large flock was seen flying in a circle at great height and then gradually descending over a chimney of Georgetown College, which they finally entered. Discussion followed by Dr. L. O. Howard and Professor E. L. Morris. The latter had noticed that individual swifts leave the flock in small parties of equal size until near the end of the flight, when the remaining birds hurry into the chimney without any regularity of procedure.

Professor T. D. A. Cockerell then opened the regular program with a paper on the 'Faunæ and Faunulæ of New Mexico,' in which he described the various life-zones of New Mexico, beginning with summits of the mountains. The different belts are usually well marked and are best designated by the names of abundant and characteristic plants, such as the spruce, piñon, scrub-oak, Dasylirion, Yucca, Larrea and *Atriplex canescens*. One of the most notable peculiarities of New Mexican conditions is that the Larrea belt, supposed to represent the Lower Sonoran zone, occurs on the bases of the mountains above *Atriplex canescens*, which is considered a more northern type. This apparent anomaly is explained by the fact that the bottoms of the valleys are visited by currents of cold air which render the changes of temperature more rigorous than at somewhat greater elevations. In all groups the species of the New Mexican region are largely peculiar, doubtless to a considerable extent the result of the fact that the naturalization of introduced species is rendered extremely difficult by the severe late frosts which native forms avoid by remaining dormant through the generally very warm weather of early spring.

In the course of the ensuing discussion Dr. Merriam explained that the conditions described by Professor Cockerell were considerably different from those studied by himself in Arizona, while Mr. Osgood noticed a close parallel in some of the valleys of California. Mr. Coville suggested that Professor Cockerell's *Atriplex* might prove to be *A. tetraptera*, *A. canescens* being a plant of more northern distribution. Dr. Loew related experience gained while a member of the Wheeler Expedition (1872–1875), which led him to the view that the cold air which collects in the bottoms of valleys sinks on account of its greater weight, causing the warm air to rise along the slopes of the mountains, which are thus maintained at a higher temperature. Dr. Merriam resumed the discussion and explained how in a similar way upward currents of warm air are formed in valleys of more heated southwestern slopes of mountains, frequently permitting the extension of the flora and fauna of the valley to an altitude sometimes 2,000 or 3,000 feet above the normal.

The next paper, 'Some Microchemical Reactions resembling Fungi,' by Dr. A. F. Woods, explained that living protoplasm of plant cells, when treated with certain reagents in common use in histological investigations, will form precipitates which closely resemble and have been mistaken for fungi supposed to be living as parasites inside the cell. Dr. Woods had been able, by adding very gradually such a reagent (*eau de Javelle*), to observe the progress, in living cells of the Bermuda lily, of a reaction closely similar to the appearances which have been described by Viala and others as a species of *Plasmodiophora* and which they believed to be the cause of a disease of the grape. The paper was illustrated by specimens and photographs.

The program was concluded by Dr. Oscar Loew with a paper on 'The Fermentation of Tobacco.' The processes of tobacco curing and fermentation were described. The rise in temperature and improvement in flavor during the latter process have been in recent years uniformly ascribed to the presence of bacteria, and many attempts to isolate the specific germ have been made, several of which have been reported as successful. Dr. Loew finds, however, that bacteria have no part in these changes, that the conditions are unfavorable for the growth of bacteria, there being too little moisture, and

finally, that even such bacteria as may have been accidentally present on the leaves are killed in the curing process. He has discovered two oxydizing enzymes the proportions of which are determining factors in the production of the color and aroma of tobacco. Faulty methods of curing may destroy these enzymes and prevent the changes which bring about improved flavor. The nicotine, which does not exist in the fresh leaf, is one of the products formed during the action of the enzymes.

Professor Whitney offered the opinion that Dr. Loew's discoveries were to be looked upon as the beginning of a scientific understanding of the processes of acquiring color and aroma, and that they marked a new departure of great scientific and practical importance. Dr. Loew then replied to various questions by Dr. de Schweinitz and others.

O. F. COOK,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 503d meeting of the Society was held in the assembly room of the Cosmos Club at 8 p. m., May 27th. The first paper was by Mr. Frank Radelfinger on 'Some Recent Researches on Linear Differential Equations.'

After a brief introduction reviewing and summarizing the methods used in the solution of differential equations before the introduction of the complex variable into analysis the work of Fuchs on the theory of linear differential equations was considered and its salient points denoted. The researches of Thomé and Poincaré on equations with irregular integrals were very briefly treated, and then came the principal part of the paper, giving an account of the recent introduction of the ideas of the Galois-group theory into the theory of the linear differential equation. The work of Picard and Vessiot was discussed. A statement of the principal theorems of the linear group was given and their analogy to those relating to the symetrical group of algebra mentioned. A concise statement of the theory of irreducibility and its application to the theory of linear differential equations was made, and it was shown that the results obtained by the group theory when combined with this idea furnished us with a rational basis for their classification. This was illustrated by making an application to the case of an equation of the second order. The conditions that must be satisfied by a linear equation in order that it may be integrated by quadratures was next discussed. In conclusion, some points to be perfected in the theory of equations with irregular integrals were indicated and mention made of recent researches in the theory of divergent series that may throw some light on these points; the importance of the group theory was mildly emphasized and a statement made of the results to be expected from its further application to the theory of linear differential equations, especially in regard to arithmetization of this theory.

The second paper was by Mr. Louis D. Bliss on 'Hertzian Waves as applied to Wireless Telegraphy and Firing of Guns from a Distance.' The substance of Mr. Bliss's remarks was as follows: Upon the electro-magnetic theory of light proposed by Maxwell in 1867 Hertz in 1888 succeeded in producing signals through space, without the aid of any material medium, by the propagation of electro-magnetic waves. For a transmitter he employed an 'Oscillator' and for a receiver a 'Resonator' of special design.

Marconi, in 1895, reduced to practical form what was thus far experimental, by the construction of a 'Coherer' or 'Electric Eye,' consisting of a glass tube filled with metal powder on which the waves could strike. The resistance of the powder was thereby greatly diminished on account of the cohesion of the particles under the influence of the waves. This permitted a battery (which was constantly in circuit) to force a powerful current through the device, and thus operate a telegraph relay or sounder, or operate a fuse to fire a cannon, mine or other device at will. These signals may now be transmitted through space between stations 30 miles apart, the height of the vertical wire which must be connected to the apparatus at each station varying as the square root of the distance. (Demonstrations of firing a cannon without wires and telegraphy through space were made.)

E. D. PRESTON,
Secretary.

SECTION OF ASTRONOMY AND PHYSICS, OF THE NEW YORK ACADEMY OF SCIENCES, MAY 1, 1899.

THE regular meeting of the Astronomy and Physics Section was held at 12 West 31st Street, New York, on May 1, 1899, Professor Pupin, the Chairman of the Section, presiding.

The first paper, describing experiments by Professor Pupin and Mr. F. Townsend, on the magnetization of iron with alternating currents, was read by Mr. Townsend. The paper was only a preliminary account, as the experiments are still in progress. The current wave in a transformer with open secondary circuit is a complex harmonic vibration, and the particular object of this research is to determine the amplitudes and phase relations of the components of the fundamental vibration.

The component due to eddy currents is determined from the curves of electromotive force and current, together with the static hysteresis loop for the given magnetization, by a graphical method. The eddy current component is found to lag behind the electromotive force. Also, the dynamic hysteresis loop is found to have a rounded point, as distinguished from the sharp point characteristic of the static loop.

The phase of the fundamental of the total current wave is found by means of a specially constructed phase meter. Its amplitude is determined from the electromotive force and total watts.

The remaining component to be determined is that due to hysteresis and induction reaction. This and the eddy current component form two sides of a parallelogram of which the fundamental of the total current wave is the diagonal. If the last two are determined in amplitude and phase the fundamental of the distorted wave of magnetizing current can readily be found.

The ultimate object of the investigation is to formulate the laws which govern the reactions accompanying the magnetization of iron by alternating currents.

The second paper was by Mr. C. C. Trowbridge on phosphorescent substances at liquid-air temperatures. Calcium sulphide, made phosphorescent by exposure to sunlight at ordinary temperatures, was made non-luminous by immersion in liquid air. Then, when allowed to heat up gradually to normal temperature, the phosphorescence again became visible at about —100° to —75° C. The same material, if exposed to sunlight while immersed in liquid air, phosphoresced faintly while still immersed. When exposed to the electric arc it phosphoresced strongly. In both of these cases the phosphorescence became brighter when the temperature was raised. From these results, and what was previously known, it was concluded that when a phosphorescent substance like calcium sulphide is excited by light the phosphorescent energy will be given up at the temperature of excitation even when as low as —190° C. But if it is cooled below the temperature of excitation the phosphorescent discharge is arrested, and remains so until the temperature is raised again until it is within at least 100° of the temperature of excitation.

It was found that calcium tungstate, which gives a whitish fluorescence when exposed to Röntgen rays, gave a green phosphorescence when exposed to light while immersed in liquid air.

WM. S. DAY,
Secretary.

DISSCUSION AND CORRESPONDENCE.

CEREBRAL LIGHT: FURTHER OBSERVATIONS.

IN SCIENCE, 1897 N. S. VI. 138, I published a set of observations to prove that what is at present considered to be retinal light arising from chemical changes in the retina is really not derived from the retina but from the brain. The observations were essentially: 1. That there was only one field of light instead of two, and that this field showed no signs of binocular union, binocular strife or stereoscopic union. 2. That the figures in the light do not change as the eye moves, but follow the movement later. 3. That the figures do not show movement when the eye is displaced by pressure with the fingers. A recent German reviewer, while admitting the possibility that the light is cerebral and not retinal, refuses to accept my observations as sufficient proof.

Last night I was able to perform what seems to be a crucial experiment; I record its results